CLAIMS

We claim:

1. A method of fabricating a layer of material in an integrated circuit (IC), the layer including a pattern, the layer defined by a layout data, the method comprising:

analyzing the layout data to determine whether substantial portions of the pattern are to be defined using a phase shifting pattern; and

responsive to the analyzing, configuring an optical lithography exposure system to have a setting of a set of one or more optical parameters that control characteristics of exposures, to expose at least a first mask pattern and a second mask pattern for use in defining the layer of material to use said setting for exposing each mask pattern, and wherein the first mask pattern comprises an alternating aperture phase shifting pattern and wherein the second mask pattern comprises a trim pattern.

2. The method of claim 1, wherein the analyzing comprises determining if all of the pattern on the layer is defined using phase shifting.

3. The method of claim 1, wherein the layout data comprises a "full phase" design such that the first mask pattern comprises a "full phase" mask pattern.

4. The method of claim 1, wherein the analyzing comprises determining if one or more of all of the pattern is defined using phase shifting, wherein a pattern is exposed on the layer which can be characterized by one or more of the following: at least eighty percent (80%) of the non-memory portions of the pattern are defined by the phase shift pattern; at least eighty percent (80%) of a part of the floorplan in the pattern is defined by the phase shift pattern; at least ninety percent (90%) of the pattern is defined by the phase shift pattern; all of the features in the critical path of the pattern are defined by the phase shift pattern; all features in the pattern except those features that are not phase shifted due to phase conflicts are defined by the phase shift pattern; everything in the pattern except test structures are defined by the phase shift pattern; and everything in the pattern except dummy structures are defined by the phase shift pattern.

5. The method of claim 1, wherein a pattern is exposed on the layer which can be characterized by having at least ninety-five (95%) of the pattern defined by the phase shift pattern.

6. The method of claim 1, wherein the optical lithography exposure system comprises at least one of a stepper and a scanner.

7. The method of claim 1, wherein the first mask pattern and the second mask pattern are on a single reticle.

8. The method of claim 1, wherein said set of optical parameters consists of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

9. The method of claim 1, wherein said set of optical parameters comprise one or more of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

10. The method of claim 1, further comprising exposing the layer of material in the optical lithography exposure system using a first dosing for the first mask pattern and a second dosing for the second mask pattern, the first dosing and the second dosing in a ratio of 1.0 to r, $r > 0.0$.

11. The method of claim 10, wherein $2.0 <= r <= 4.0$.

12. The method of claim 10, wherein the first mask pattern and the second mask pattern are on a single reticle.

13. The method of claim 12, wherein the exposing further comprises blading the first mask pattern and second mask pattern during the exposing to permit different dosing.

14. The method of claim 12, and wherein the single reticle further includes a second instance of the second mask pattern and wherein the exposing comprises exposing the layer of material to the single reticle in a pattern to cause a 1:2 exposure ratio between the first mask pattern and instances of the second mask patterns.

15. A reticle for use in defining a pattern in a layer of material of an integrated circuit (IC) production using optical lithography in an optical lithography exposure system having a set of one or more optical parameters that control characteristics of exposures, the reticle for defining a layer of material in an IC, the reticle comprising at least two patterns:

a first pattern comprising a phase shifting mask; and

a second pattern comprising a trim mask,

the first pattern defining a sufficient amount of the layer of material using phase shifting to allow the use of substantially the same settings of said set of one or more optical parameters for both the first pattern and the second pattern.

16. The reticle of claim 15, wherein a pattern is exposed on the layer which can be characterized by one or more of the following: at least eighty percent (80%) of the non-memory portions of the pattern are defined by the phase shift pattern; at least eighty percent (80%) of a part of the floorplan in the pattern is defined by the phase shift pattern; at least ninety percent (90%) of the pattern is defined by the phase shift pattern; all of the features in the critical path of the pattern are defined by the phase shift pattern; all features in the pattern except those features that are not phase shifted due to phase conflicts are defined by the phase shift pattern; everything in the pattern except test structures are defined by the phase shift pattern; and everything in the pattern except dummy structures are defined by the phase shift pattern.

17. The reticle of claim 15, wherein a pattern is exposed on the layer which can be characterized by having at least ninety-five (95%) of the pattern defined by the phase shift pattern.

18. The reticle of claim 15, wherein said set of optical parameters consists of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

19. The reticle of claim 1, wherein said set of optical parameters comprise one or more of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

20. The method of claim 15, wherein substantially the same comprises within plus or minus 10%.

21. The reticle of claim 15, wherein the reticle further includes a third pattern substantially identical to the second pattern, such that the layer defined by a triple exposure comprising one exposure by the first pattern, one exposure by the second pattern, and a third exposure by the third pattern.

22. The reticle of claim 15, wherein the reticle further includes a third pattern comprising a phase shifting pattern, and wherein the first pattern for defining features oriented in a first direction in the pattern and the third pattern for defining oriented in a second direction features in the pattern, such that the layer defined by a triple exposure comprising one exposure by the first pattern, one exposure by the second pattern, and a third exposure by the third pattern.

23. An method of manufacturing an integrated circuit (IC) product comprising:

defining at least one layer of material in the IC using at least two mask patterns, the layer of material comprising a pattern, the first mask pattern comprising a phase shifting pattern and the second mask pattern comprising a trim pattern, the first pattern defining substantially all of the pattern of the layer of material and the second pattern for protecting the pattern and clearing phase shifting artifacts;

exposing layer of material in an optical lithography exposure system having a setting of a set of one or more optical parameters that control characteristics of exposures, to the first mask

pattern and the second mask pattern, where said setting is substantially the same while exposing the first and second mask patterns.

24. The method of manufacturing an IC product of claim 23, wherein the first mask pattern comprises a “full phase” mask.

The method of manufacturing an IC product of claim 0, wherein the pattern on the layer of material can be characterized by one or more of the following: at least eighty percent (80%) of the non-memory portions of the pattern are defined by the phase shift pattern; at least eighty percent (80%) of a part of the floorplan in the pattern is defined by the phase shift pattern; at least ninety percent (90%) of the pattern is defined by the phase shift pattern; all of the features in the critical path of the pattern are defined by the phase shift pattern; all features in the pattern except those features that are not phase shifted due to phase conflicts are defined by the phase shift pattern; everything in the pattern except test structures are defined by the phase shift pattern; and everything in the pattern except dummy structures are defined by the phase shift pattern.

25. The method of manufacturing an IC product of claim 23, wherein the pattern on the layer of material can be characterized by having at least ninety-five (95%) of the pattern defined by the phase shift pattern.

26. The method of manufacturing an IC product of claim 23, wherein the optical lithography exposure system comprises at least one of a stepper and a scanner.

27. The method of manufacturing an IC product of claim 23, wherein the first mask pattern and the second mask pattern are on a single reticle.

28. The method of manufacturing an IC product of claim 23, wherein said set of optical parameters consists of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

29. The method of manufacturing an IC product of claim 23, wherein said set of optical parameters comprise one or more of the numerical aperture (N.A.), wavelength (λ) of radiation, partial coherency (σ), illumination configuration, and defocus.

30. The method of manufacturing an IC product of manufacturing an IC product of claim 23, wherein substantially the same comprises within plus or minus 10%.

31. The method of manufacturing an IC product of claim 23, wherein the exposing further comprises using a first dosing for the first mask pattern and a second dosing for the second mask pattern, the first dosing and the second dosing in a ratio of 1.0 to r, $r > 0.0$.

32. The method of manufacturing an IC product of claim 31, wherein $2.0 <= r <= 4.0$.

33. The method of manufacturing an IC product of claim 23, wherein the first mask pattern and the second mask pattern are on a single reticle.

34. The method of manufacturing an IC product of claim 33, and wherein the exposing further comprises blading the first mask pattern and second mask pattern on the reticle during the exposing to permit different dosing.

35. The method of manufacturing an IC product of claim 33, and wherein the single reticle further includes a second instance of the second mask pattern and wherein the exposing comprises exposing the layer of material to the instances of the mask patterns on the single reticle in a sequence to cause a 1:2 exposure ratio between the first mask patterns and instances of the second mask pattern.

36. A method for manufacturing an integrated circuit, comprising:

forming a layer of resist on a wafer;

exposing the layer to a first dose of radiation through a phase shifting pattern in a mask, the radiation characterized by set of one or more parameters selected for exposure of the phase shifting pattern; and

exposing the layer to a second dose of radiation through a trim pattern in a mask, the radiation characterized by said set of parameters.

37. The method of claim 36, wherein said set of parameters includes a parameter indicating partial coherence σ of the radiation at the layer.

38. The method of claim 36, wherein said set of parameters includes a parameter indicating the numerical aperture NA of the radiation at the layer.

39. The method of claim 36, wherein said set of parameters includes a parameter indicating an axis of propagation of the radiation at the layer.

40. The method of claim 36, wherein said set of parameters includes a parameter indicating an illumination configuration of the radiation.

41. The method of claim 36, wherein said set of parameters includes a parameter indicating defocus of the radiation at the layer.

42. The method of claim 36, wherein said set of parameters includes parameters indicating numerical aperture NA of the radiation at the layer, partial coherence σ of the radiation at the layer, an axis of propagation of the radiation at the layer, an illumination configuration of the radiation, and defocus of the radiation at the layer.

43. The method of claim 36, wherein said first dose and said second dose are different.

44. The method of claim 36, wherein said phase shift pattern and said trim pattern are on a single mask.

45. The method of claim 36, wherein a pattern is exposed on the layer which can be characterized by one or more of the following: at least eighty percent (80%) of the non-memory portions of the pattern are defined by the phase shift pattern; at least eighty percent (80%) of a

part of the floorplan in the pattern is defined by the phase shift pattern; at least ninety percent (90%) of the pattern is defined by the phase shift pattern; all of the features in the critical path of the pattern are defined by the phase shift pattern; all features in the pattern except those features that are not phase shifted due to phase conflicts are defined by the phase shift pattern; everything in the pattern except test structures are defined by the phase shift pattern; and everything in the pattern except dummy structures are defined by the phase shift pattern.

46. The method of claim 36, wherein a pattern is exposed on the layer which can be characterized by having at least ninety-five (95%) of the pattern defined by the phase shift pattern.

47. The method of claim 36, wherein said set of parameters comprises parameters that are changed by a mechanical adjustment of an optical element.

48. A method for manufacturing an integrated circuit, comprising:

forming a layer of resist on a wafer in a first process station;

moving the wafer to a second process station including a radiation source, a mask and an optical path for exposing the wafer to radiation, the optical path being characterized by a set of optical parameters including one or more of a wavelength λ of illumination, numerical aperture NA, coherence, illumination configuration, and defocus;

exposing, in the second process station, the layer to a first dose of radiation through a phase shifting pattern in said mask using a first setting of set of optical parameters; and

exposing, in the second process station, the layer to a second dose of radiation through a trim pattern in said mask using said first setting.

49. The method of claim 48, wherein said set of optical parameters includes the numerical aperture and partial coherence σ.

50. The method of claim 48, wherein said set of optical parameters includes the numerical aperture NA, partial coherence σ, the illumination configuration, and the defocus.

51. The method of claim 48, wherein said set of optical parameters includes partial coherence σ as the coherence parameter.

52. The method of claim 48, wherein said first dose and said second dose have different dosage levels.

53. The method of claim 48, wherein a pattern is exposed on the layer which can be characterized by one or more of the following: at least eighty percent (80%) of the non-memory portions of the pattern are defined by the phase shift pattern; at least eighty percent (80%) of a part of the floorplan in the pattern is defined by the phase shift pattern; at least ninety percent (90%) of the pattern is defined by the phase shift pattern; all of the features in the critical path of the pattern are defined by the phase shift pattern; all features in the pattern except those features that are not phase shifted due to phase conflicts are defined by the phase shift pattern; everything in the pattern except test structures are defined by the phase shift pattern; and everything in the pattern except dummy structures are defined by the phase shift pattern.

54. The method of claim 48, wherein a pattern is exposed on the layer which can be characterized by having at least ninety-five (95%) of the pattern defined by the phase shift pattern.

55. The method of claim 48, wherein said set of parameters comprises parameters that are changed by a mechanical adjustment of an optical element.